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N° 26,225 A.D. 1910

Date of Application, 11th Nov., 1910

Complete Specification Left, 11th May, 1911—Accepted, 13th Nov., 1911

PROVISIONAL SPECIFICATION.

Improvements in Machines for Winding Armatures of Dynamo-electric Machines, and for analogous purposes.

We, Boultbee Brooks, Director of Public Company, of Criterion Works, Great Charles Street, Birmingham, and Frank Herbert Alston, of Green Lanes, Small Heath, Birmingham, Electrician, do hereby declare the nature of this invention to be as follows:—

This invention relates to a machine for winding shuttle-wound armatures of dynamo-electric machines, particularly the armatures of magneto-electric machines employed in the ignition systems of internal combustion engines. The invention is, however, also applicable to other analogous purposes, such as for winding induction coils.

The principal object of the present invention is to provide an improved construction of machine by which the armature or the like can be quickly and evenly wound, in which the wire is always guided close to the surface of the armature so as to ensure the perfect regularity of the winding and which is arranged to be automatically stopped as each layer is completed, or in the event of the wire breaking during the winding operation. Another object is to provide means for testing for breaks or faults in the wire whilst the said winding is in progress, thus obviating the necessity of unwinding the coil in order to locate and repair faults when situated in unknown positions.

According to the said invention, the armature is arranged to be continuously rotated, and the even winding of the wire over the core is ensured by a traversing guide which receives its motion from a fine-pitched screw driven from the main spindle, the said guide being held close against the said armature by the tension of the wire, and, in the event of the said wire breaking, being adapted to cause the driving belt to be shifted on to a loose pulley and the machine stopped this being effected preferably by the closing of an electric circuit, or (when electrically driven) by the short-circuiting of an electro-magnetic switch in the motor circuit.

In carrying out the invention in connection with a machine for winding the secondary circuits of the armatures of high-tension magneto machines, the improved winder comprises a main driving shaft or mandril mounted to revolve within bearings carried by standards supported upon a base, and adapted to be driven from a suitable source of power by means of a belt passing around a pulley. A loose pulley is also provided on to which the belt can be shifted when the machine is to be stopped. The end of the spindle is provided with a chuck or carrier by which the armature core can be supported and rotated with its transverse axis arranged in the direction of the length of the mandril. Thus one of the pole-pieces of the armature may fit between a pair of lugs or ears at opposite sides of the carrier, and may be temporarily secured thereto by screws or other fixing means. Arranged beneath the mandril and driven therefrom through suitable gearing, is a longitudinal rotating screw. Surrounding this screw is a nut or internally wormed sleeve connected by an arm to a slidable shaft capable of moving endwise in guides. Hinged or pivotally mounted on this sliding shaft, and moving therewith, is a guide arm for guiding the wire evenly on to the core of the armature. At the lower end it carries

[*Price* 8*d*.]

upon its front face a guide pulley over which the wire passes, whilst at its upper end, it is provided with a curved and grooved guide part through which the wire is led directly on to the armature. The guide arm tends to fall away from the armature, but when the winding is in progress the tension of the wire constantly keeps its upper grooved end close to the surface of the core, so as to follow the shape of the latter, a roller being provided behind said upper end which bears and runs upon said surface. As the winding proceeds the feed screw causes the guide arm to move slowly over the face of the core from one end to the other at the same rate as the layer being wound increases in width, and so ensures the even and regular winding.

Preferably the distance that the guide arm moves through for each rotation of the armature is slightly greater than the diameter of the wire; and by increasing the pitch of the feed screw the turns may be considerably separated, so that bare wire can be used.

In order to reverse the direction of travel of the guide arm after each layer has been completed and insulated, a simple reversing device is provided in connection with the gear train. Thus mounted upon a rocker plate are two small pinions in mesh with one another. For the traverse of the guide in the one direction (say towards the left) one of the pinions is in mesh with the driving wheel on the mandril and directly transmits the drive to the follower wheel with which it gears, whereas for reversing the traverse of the said guide the second pinion on the rocker is taken into mesh with the driving wheel, whereby the drive is transmitted through both the pinions to the follower, thus reversing the direction of rotation of the feed screw. The rocker may be actuated by an operating handle or arm passing through a slot in a quadrant plate, a sliding spring-pressed knob being adapted to be taken into engagement with one or other of two sets of gates or recesses in said quadrant and thus lock the rocker in the required position. A third gate may be provided for holding the rocker with both pinions out of mesh with the driving wheel.

To move the belt from the fast to the loose pulley, or *vice versa*, in order to stop or start the machine, a rocking belt fork is provided which is carried at its lower end upon a transverse spindle turning in bearings on the base and fitted with a lever handle at the front by which the fork can be rocked over from one position to the other.

In order to automatically effect the stopping of the machine as soon as each layer is wound, or in the event of the wire breaking during the winding operation, the spindle upon which the belt fork is mounted, has fixed upon its rear end a longitudinally arranged lever or rocker beneath one end of which a spring is arranged to act, so as to tend to move the belt fork into its position in which the belt is on the loose pulley. As the belt is shifted on to the fixed pulley the spring is compressed, and the outer end of the rocking lever wipes over, and is engaged by, a catch element carried upon a pivotted and spring-actuated armature of an electro-magnet. The belt fork is thus held in the position in which the belt drives the fixed pulley.

Beneath the armature being wound is a metallic arch or bridge piece, arranged in a longitudinal direction, and having an opening passing through which is a rod or arm attached to and projecting rearwards from the lower end of the traversing wire guide, and adapted, as each layer of the winding is completed, to make contact with the side of the arch, the length of the latter being greater than the required width of the layer by the thickness of the contact arm. Preferably the said length of the arch is adjustable, a battery or other electric generator has one pole connected up to the electro-magnet and the other pole connected to the arch, so that as soon as the bar carried by the guide arm makes contact, as above described, as each layer is finished, the electric circuit is completed through the frame of the machine. The electro-magnet is thus energised and attracts its armature, so disengaging the catch from the rocking lever, breaking the circuit, and allowing the belt fork to be thrown over, by

the spring, so as to shift the belt on to the loose pulley, thus stopping the machine. The layer just completed is then covered with paper or other insulation, and the direction of travel of the guide arm is reversed by the device previously described, the machine being again set in motion by moving the belt on to the fixed pulley by means of the hand lever at the front, causing the catch on the electro-magnet to again engage and make contact with the rocking lever until the next layer is completed, when the machine is again stopped in the manner described.

Should the wire break whilst the winding is in progress the guide arm, being relieved of the tension of the said wire will fall away from the armature being wound, causing the rearwardly-projecting bar carried by its lower end to rise, and make contact with the top bar of the arch or bridge-piece, so closing the circuit through the electro-magnet which attracts its armature and releases the rocking lever fixed upon the belt-fork spindle, so shifting the belt on to the loose pulley and stopping the machine, in exactly the same manner as when a layer of the winding is completed.

To automatically give the usual contour to the winding and form the outer layers of gradually decreasing width, the under edge of the top bar of the arch or bridge-piece is given a proportional profile to the desired contour, so that as the armature becomes filled the projecting contact arm of the guide arm gradually rises in the opening of the arch and makes contact with the latter sooner than when the full layer is being wound, and so stops the machine at an earlier moment, thereby gradually decreasing the length of the layers with each successive traverse of the guide arm.

When the armature is sufficiently full the contact arm reaches the top of the arch and renders it impossible for any further winding to take place.

To stop the machine by hand, an emergency push-button or the like may be employed for closing the electric circuit, so as to cause the belt-fork catch to be released.

In order to test the wire for breaks or faults whilst the winding is in progress, a current is arranged to be passing through the whole of the wire, both upon the armature and upon the paying-out bobbin, with a galvanometer or other suitable instrument in the circuit, so that should the wire be broken an indication is given by the needle of the instrument returning to zero.

To prevent over-running of the bobbin it is provided with a brake which comes into operation as soon as the "pull" of the wire ceases, as described in the Specification of our previous Letters Patent No. 11,170 of 1908.

Instead of the automatic stopping of the machine being effected by the closing of an electric circuit or by the short circuiting of an electro-magnetic switch in the driving motor circuit, a mechanical device, such as a clutch, may be arranged to be actuated in order to disconnect the source of power from the winding apparatus.

Dated this 10th day of November, 1910.

BOULTBEE BROOKS.
FRANK HERBERT ALSTON.
By Henry Skerrett,
Agent for Applicants.

COMPLETE SPECIFICATION.

Improvements in Machines for Winding Armatures of Dynamo-electric Machines, and for analogous purposes.

We, BOULTBEE BROOKS, Director of Public Company, of Criterion Works, Great Charles Street, Birmingham, and FRANK HERBERT ALSTON, of Green

Lanes, Small Heath, Birmingham, Electrician, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to a machine for winding shuttle type armatures of dynamo-electric machines, particularly the armatures of magneto-electric machines employed in the ignition systems of internal combustion engines. The invention is, however, also applicable to other analogous purposes, such as for winding induction and other coils, bobbins, and the like, where it is necessary to insulate each layer from the next.

The improved machine is of that type in which the even winding of the wire is ensured by a traversing wire guide which receives its motion from a screw driven from the main spindle, the machine being automatically stopped when the wire breaks, by the closing of an electric circuit through suitable electro-magnets which operate means by which the stopping of the machine is brought about, such as by the throwing-out of a clutch.

The principal object of the present invention is to provide an improved construction of the above type of machine in which the guide arm is pivotally and freely mounted and kept in contact with the armature or the like by the tension of the wire so as to always closely follow the surface or sectional contour of the said armature or the like, and which, in the event of the wire breaking, moves away from the said armature and operates means whereby the machine is stopped. The improved machine is also arranged to be automatically stopped as each layer is completed.

Figure 1 of the accompanying drawings represents a front elevation of the improved armature winding machine, same being shown in its stopped or non-running condition.

Figure 2 is a plan of the machine.

Figure 3 is a part sectional elevation of the machine in its running condition.

Figure 4 shows how the ordinary contour is given to the outer layers of the winding.

Figure 5 is a longitudinal section showing in elevation the arch or bridge piece which controls the automatic stopping of the machine.

Figure 6 represents a rear view, partly in section, of the improved machine, showing the electro-magnetically operated catch device and the belt-shifting fork and lever in elevation.

Figure 7 is a cross-section showing how the wire guide arm bears upon and follows the contour of the armature.

Figure 8 illustrates how the guide arm can be allowed to fall away from the armature when required.

Figure 9 is a similar view to Figure 7, but shows the guide arm bearing upon the armature when the latter is in a horizontal position. It also represents, in dotted lines, the position the guide arm takes in the event of the wire breaking.

Figure 10 represents an end view of the machine.

Figure 11 is a section showing the reversing gear in its mid position, with the intermediate pinions out of gear wth the driving wheel.

Figure 12 is a similar section showing the reversing gear in one of its running positions.

Figure 13 is a section showing the shape of the gate in the quadrant plate of the reversing gear.

The same letters of reference indicate corresponding parts in each of the figures of the drawings.

The improved winder comprises a main driving shaft or mandril 1 mounted to revolve within bearings carried by standards 2, 2, supported upon a base 3, and adapted to be driven from a suitable source of power by means of a belt passing around a pulley 4. A loose pulley 5 is also provided on to which the belt can be shifted when the machine is to be stopped, as hereafter described. The one end of the mandril carries a fly-wheel, while the other end is provided

with a chuck or carrier 6 by which the armature core 7 can be supported and rotated with its transverse axis arranged in the direction of the length of the mandril. One of the pole-pieces of the armature is arranged to fit between a pair of lugs or plates 8, 8, at the opposite sides of the carrier, and is temporarily secured thereto by screws or other fixing means. Arranged beneath the mandril 1, and driven therefrom through suitable gearing, is a longitudinal rotating screw 9 confined against endwise movement. Surrounding this screw is a travelling nut or internally wormed sleeve 10 connected by an arm 11 to a slidable shaft 12 capable of moving endwise within guides. Loosely mounted on this sliding shaft, and confined between collars 13, 14, is a sleeve 15 carrying a guide arm 16 for guiding the wire evenly on to the core of the armature. At the lower end it carries upon its front face a guide pulley 17 over which the wire passes, and a guide loop 18, whilst at its upper end, it is provided with a curved and grooved guide part 19 through which the wire is led directly on to the armature. The guide arm 16 tends to fall away from the armature into the position shown in dotted lines in Figure 9, but when the winding is in progress the tension of the wire constantly keeps its upper grooved end close to the surface of the core, as seen in Figures 7 and 9, so as to follow the shape of the latter, a roller 20 being provided behind said upper end 19 which bears and runs upon said surface. As the winding proceeds the feed screw 9 causes the guide arm to move slowly over the face of the core from one end to the other at the same rate as the layer being wound increases in width, and so ensures the even and regular winding.

Preferably the distance that the guide arm moves through for each rotation of the armature is slightly greater than the diameter of the wire; and by increasing the pitch of the feed screw the turns may be considerably separated, so that bare wire can be used, or the distance between the turns of the winding may be varied by using change wheels, so as to alter the gear ratio between the driving spindle and the screw.

In order to reverse the direction of travel of the guide arm after each layer has been completed and insulated a simple reversing device is provided in connection with the gear train. Thus, mounted upon a rocker plate 21 are two small pinions 22, 23, (Figures 11 and 12) in mesh with one another. For the traverse of the guide in the one direction (say towards the left, the mandril, as seen from the right hand end, revolving in a clockwise direction) the pinion 22 is brought into mesh with the driving wheel 24 on the mandril, so that the drive is transmitted through said pinion to a follower wheel 25 carried upon a shaft 26 turning in bearings in the standard 2, and having mounted upon its outer end a pinion 27 which gears with a wheel 28 upon the feed-screw 9. For reversing the traverse of the guide arm 16 the second pinion 23 on the rocker is taken into mesh with the driving wheel 24; whereby the pinion 22 is taken out of mesh and the drive transmitted through both the pinions to the follower 25, thus reversing the direction of rotation of the feed screw. The rocker 21 is actuated by an operating handle or arm 29 passing through a slot 30 in a quadrant plate 31, a sliding spring-pressed knob 32 having locking keys 33 being adapted to be taken into engagement with one or other of two sets of gates or recesses 34, 35, in said quadrant so as to lock the rocker in the required position. A third gate 36 is provided for holding the rocker with both pinions 22, 23, out of mesh with the driving wheel 24, as in Figure 11. This position is used in setting the position of the guide arm when starting and also when finally binding the armature after the winding is finished.

The feed screw may as shown, have an extension at its outer end provided with a knob by which it can be turned by hand so as to set the guide arm in any position when the rocker 21 is in the mid position.

To move the belt from the fast pulley 4 to the loose pulley 5, or *vice versa*; in order to stop or start the machine a rocking belt fork 37 is provided which is carried at its lower end upon a transverse spindle 38 turning in bearings 39

on the base and fitted with a lever handle 40 at the front by which the fork can be rocked over to move the belt on to the fast pulley.

In order to automatically effect the stopping of the machine as soon as each layer is wound, or in the event of the wire breaking during the winding operation, the spindle 38 upon which the belt fork is mounted, has fixed upon its rear end a longitudinally arranged lever or rocker 41 beneath one end of which a spring 42 is arranged to act, so as to tend to move the belt fork into its position in which the belt is on the loose pulley (Figure 1). As the belt is shifted on to the fixed pulley by the lever 40 the spring is compressed, and the outer end of the rocking lever wipes over, and is engaged by, a catch element 43 carried upon a pivoted and spring-actuated armature 44 of an electro-magnet 45. The belt fork 37 is thus held in the position in which the belt drives the fixed pulley (Figures 3 and 6).

Beneath the armature 7 is an insulated metallic arch or bridge piece 46, arranged in a longitudinal direction, and having an opening 47 passing through which is a rod or arm 48 attached to, and projecting rearwards from, the sleeve 15 carrying the traversing wire guide arm 16, and adapted, as each layer of the winding is completed, to make contact with the side of the arch, the length of the latter being greater than the required width of the layer by the thickness of the said arm 48. The arch is adjustable in position both vertically and longitudinally, and its length may also be adjustable. A battery or other electric generator has one pole connected to a terminal 49 coupled up to the electro-magnet 45, and the other pole is connected to the terminal 50 in electrical connection with the arch, so that when the arm 48 makes contact, as above described, as each layer is finished, the electric circuit is completed, *viz.*, from terminal 49, to electro-magnet 45, armature 44, lever 41, base 3 (which is made of metal, standards 2, 2, shaft 12, sleeve 15, arm 48, arch 46, and terminal 50. The electro-magnet is thus energised and attracts its armature, so disengaging the catch 43 from the rocking lever 41 at the same time breaking the circuit, and allowing the belt fork to be thrown over, by the spring 42, so as to shift the belt on to the loose pulley 5, thus stopping the machine. The layer just completed is then covered with paper or other insulation, and the direction of travel of the guide arm is reversed by the device previously described the machine being again set in motion by moving the belt on to the fixed pulley by means of the hand lever 40 at the front, causing the catch on the electro-magnet to again engage and make contact with the rocking lever 41 until the next layer is completed, when the machine is again stopped in the manner described. The lever 40 is moved slowly over so that the belt rotates the fixed pulley and the arm 48 moves out of contact with the arch 46 before the lever 41 engages with the catch on the magnet armature, thus preventing the circuit from being re-made and the magnet re-energised immediately on starting.

Should the wire break whilst the winding is in progress the guide arm 16 being relieved of the tension of the said wire, will fall away from the armature, causing the rearwardly projecting arm 48 to rise, as shown in dotted lines Figure 9, and make contact with the top of the arch 46, so closing the circuit through the electro-magnet, which attracts its armature and releases the rocking lever 41, so shifting the belt on to the loose pulley and stopping the machine, in exactly the same manner as when a layer of the winding is completed, as previously described.

To automatically give the usual contour to the winding and form the outer layers of gradually decreasing width, so as to come within the circular form of the armature the under edge of the top bar of the arch 46 is given a proportional profile to the desired contour, so that as the armature becomes filled the projecting contact arm 48 of the guide arm gradually rises in the opening of the arch and makes contact with the latter sooner than when the full layers are being wound, and so stops the machine at an earlier moment thereby gradually

decreasing the length of the layers with each successive traverse of the guide arm.

When the armature is sufficiently full the contact arm 48 reaches the top of the arch and renders it impossible for any further winding to take place.

To facilitate the wrapping of the armature after the winding is completed, the end of the arm 48 carries a detachable end cap 51 which, when pulled off, allows of the guide arm falling away from the armature as shown in Figure 8.

To stop the machine by hand, an emergency push-button or the like may be employed for closing the electric circuit, so as to cause the belt-fork catch to be released.

In order to test the wire for breaks or faults whilst the winding is in progress, a current may be arranged to be passing through the whole of the wire, both upon the armature and upon the paying-out bobbin, with a galvanometer or other suitable instrument in the circuit, so that should the wire be broken or a joint imperfectly made an indication is given by the needle of the instrument returning to zero. This method of testing, however, forms no part of the present invention.

To prevent over-running of the bobbin 52 upon which the wire is wound, it is provided with a brake 53 which comes into operation as soon as the pull of the wire ceases, as described in the Specification of Letters Patent No. 11,170 of 1908, the said wire passing over a spindle 54, mounted upon the lever 55, carrying the said brake, which latter is taken into contact with the drum 56 by a spring when the pressure upon the spindle 54 is relieved.

In a modification the feed screw may take the place of the shaft 12, and the guide arm carried by a nut surrounding and adapted to be traversed by the said screw.

Having now particularly described and ascertained the nature of our said invention, and in what manner the same is to be performed, we declare that what we claim is:—

1. A machine for winding armatures of dynamo-electric machines and for analogous purposes, comprising means for rotating the armature or the like, and a pivotally mounted traversing wire guide adapted to be traversed longitudinally from a rotating feed-screw, and which is kept in contact with the surface of the armature or the like by the tension of the wire, the said guide arm being adapted, in the event of the wire breaking, to move away from the armature and to operate means whereby the machine is stopped, substantially as herein described.

2. A machine for winding armatures of dynamo-electric machines and for analogous purposes, comprising a main driving shaft having means for carrying the armature or the like, a rotatable feed-screw driven from said shaft, a traversing nut or internally wormed sleeve upon said feed-screw and connected by an arm to a longitudinally sliding shaft moving in guides, and a traversing guide arm pivotally mounted upon and confined against longitudinal movement on said shaft and moving therewith over the surface of the armature for guiding the wire on to the latter, said guide arm being kept in contact with the surface of the armature or the like by the tension of the wire, and adapted in the event of the wire breaking to move away from the said armature and to operate means whereby the machine is stopped, substantially as herein described.

3. A machine for winding armatures of dynamo-electric machines and for analogous purposes, as claimed in the preceding claims; the employment of a pivotally mounted traversing wire guide arm, kept in contact with the armature or the like by the tension of the wire, and which carries a rigid contact arm extending transversely to the direction of travel and moving between fixed contact parts with one or other of which it is adapted to make contact when it reaches opposite ends of its travel so as to complete an electric circuit through an electro-magnet whose armature is thereby attracted so as to release a spring-

controlled lever connected with a belt-shifting fork, which is caused to move the driving belt on to a loose pulley and thus stop the machine, substantially as herein described and set forth.

4. A machine for winding armatures of dynamo-electric machines and for analogous purposes, as claimed in Claim 3, wherein the contact arm carried by the guide arm makes contact, in the event of the wire breaking, with the top of a metallic arch so as to complete the circuit through the electro-magnet and automatically stop the machine, substantially as herein described and set forth.

5. In a machine for winding armatures of dynamo-electric machines and for analogous purposes, as claimed in Claim 3 or 4; the employment of a contact arch or bridge-piece with which the contact arm engages when it reaches either end of its travel, and wherein the under edge of the top bar has a profile proportional to the contour it is desired to give to the winding, so as to automatically produce the said contour substantially as and for the purposes herein described and set forth.

6. The improved machine for winding armatures of dynamo-electric machines and for analogous purposes, constructed, arranged, and operating as herein described and set forth.

Dated this 10th day of May, 1911.

BOULTBEE BROOKS.
FRANK HERBERT ALSTON.
By Henry Skerrett,
24, Temple Row, Birmingham,
Agent for Applicants.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1911.

A.D. 1910. Nov. 11. N° 26,925.
BROOKS & another's COMPLETE SPECIFICATION.

(4 SHEETS)
SHEET 1.

[This Drawing is a reproduction of the Original on a reduced scale]

Fig. 1.

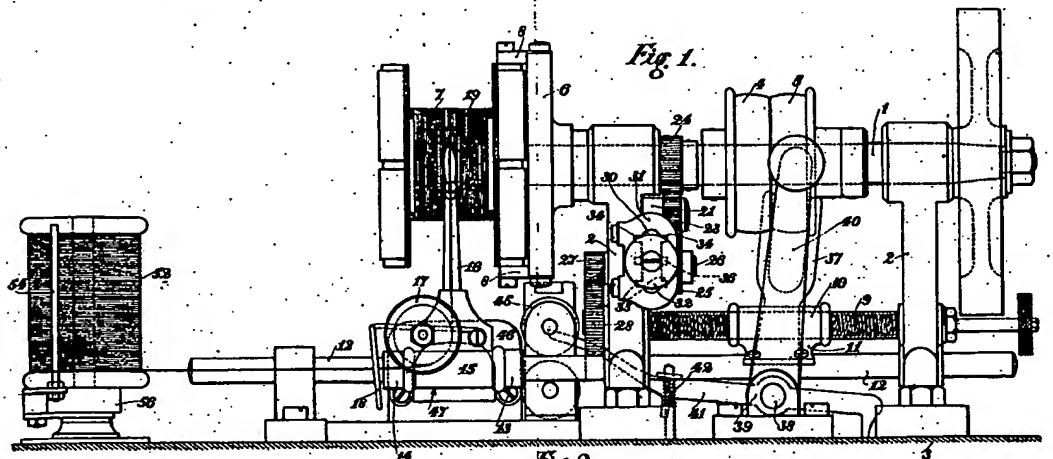
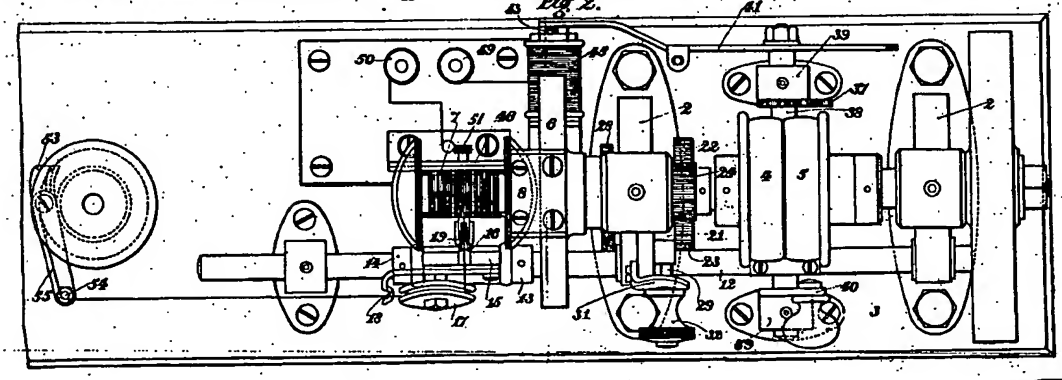
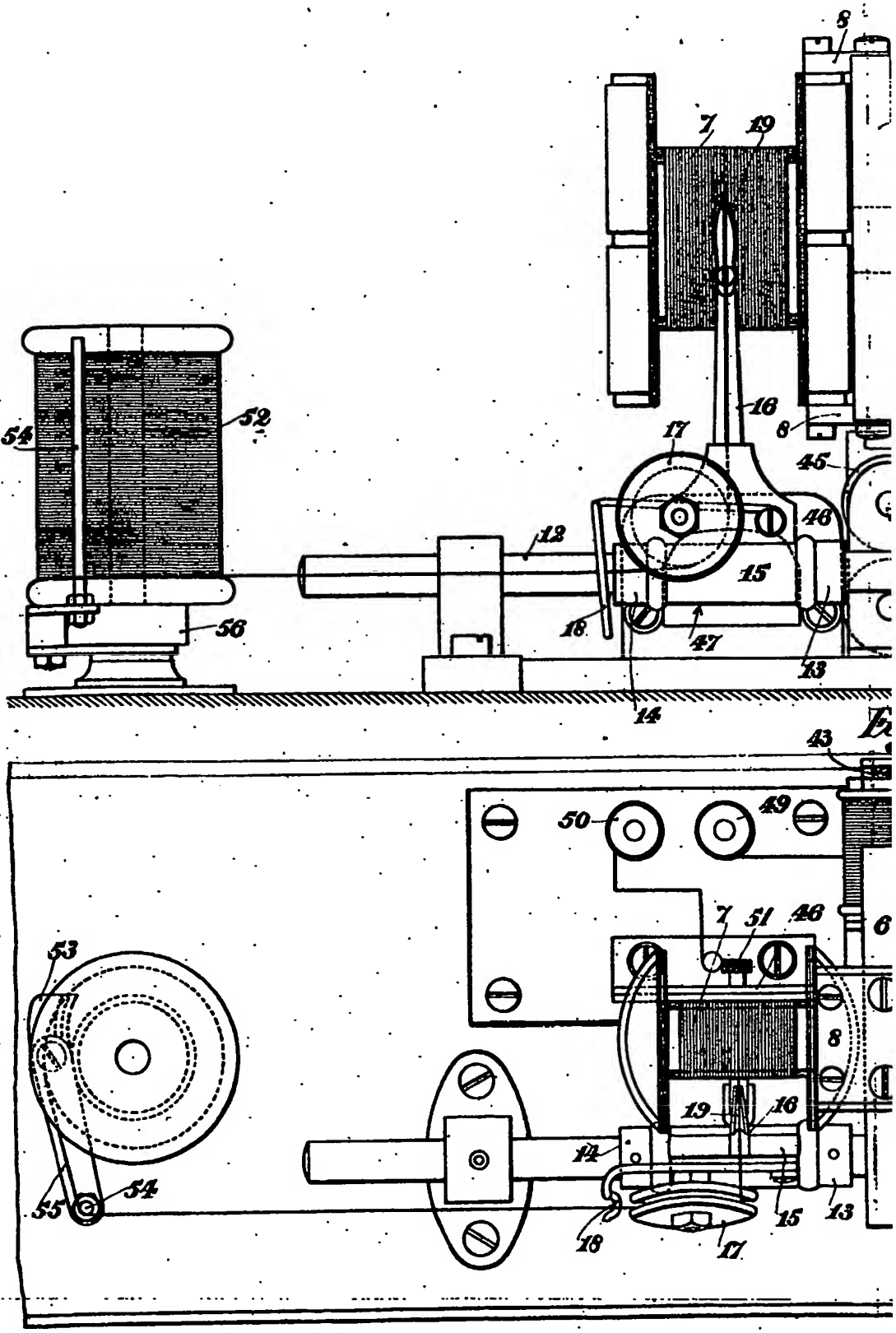


Fig. 2.





[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 1.

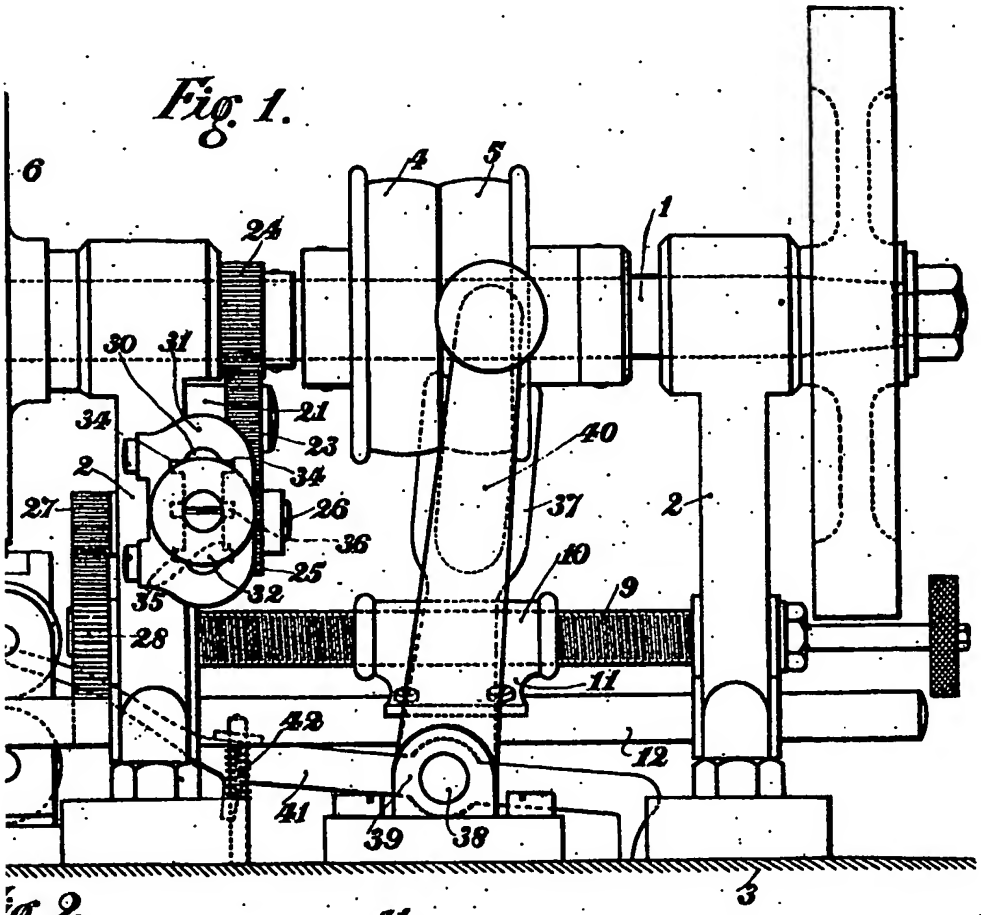
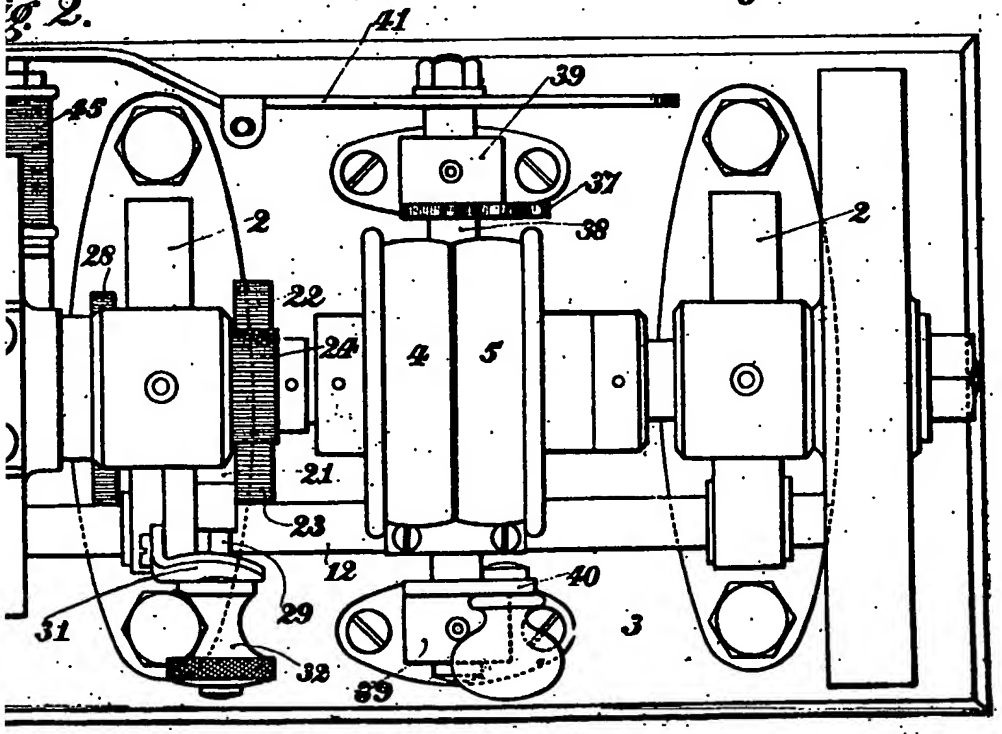


Fig. 2.



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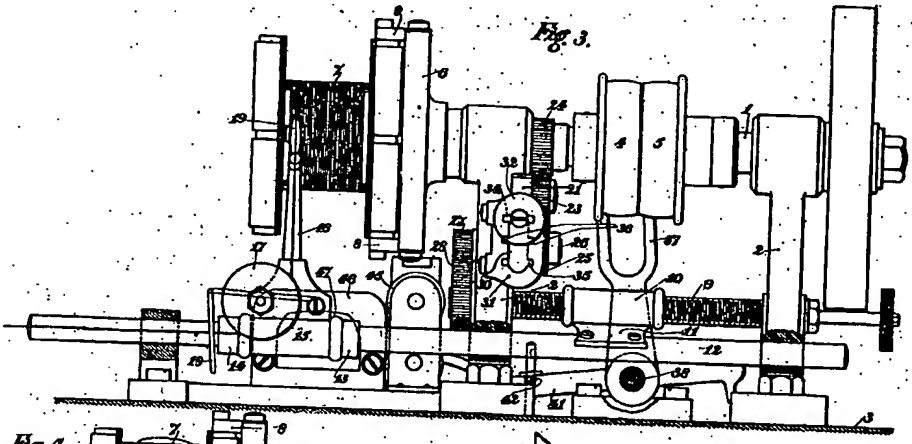


Fig. 4.

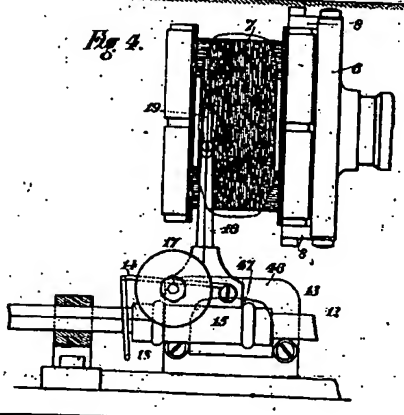
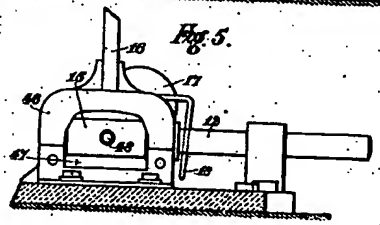


Fig. 5.



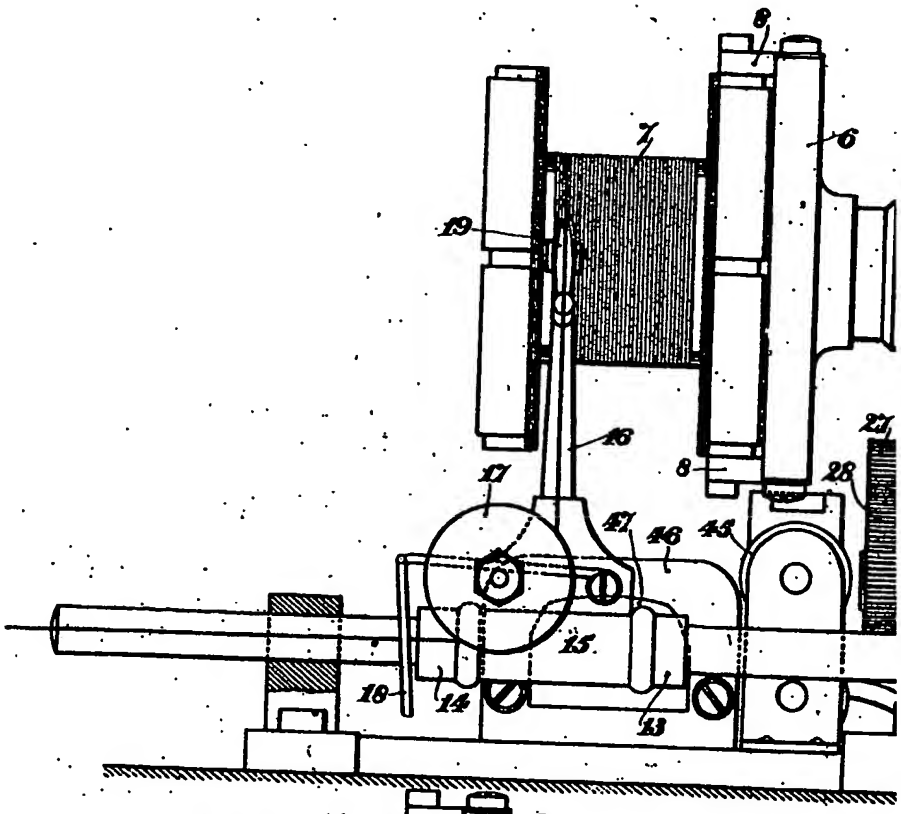


Fig. 4.

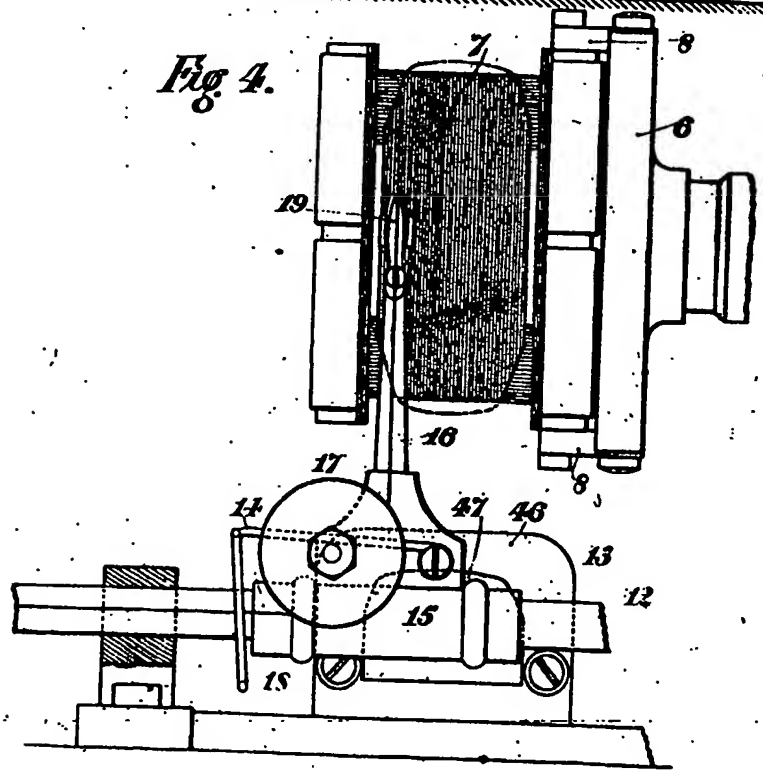


Fig. 3.

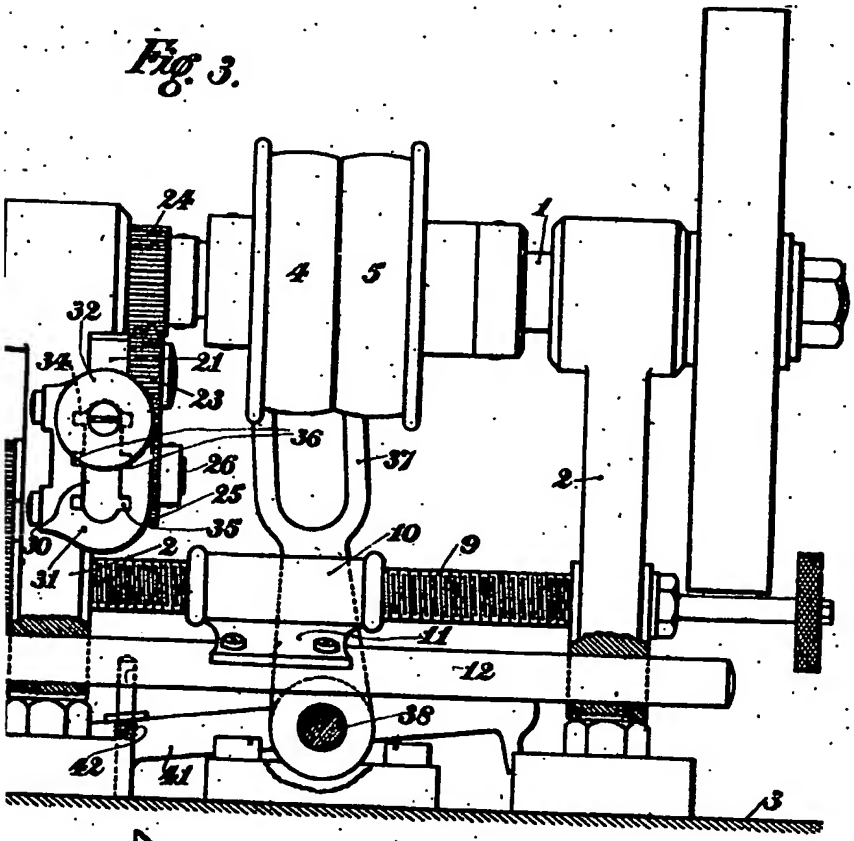


Fig. 5.

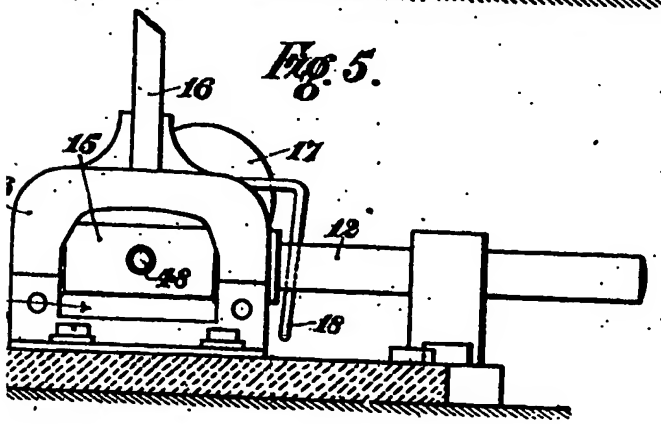


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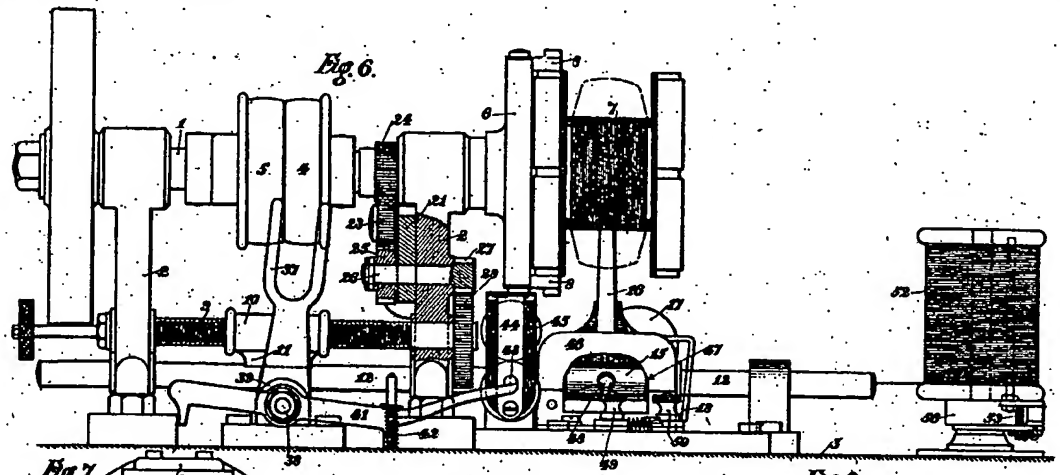
Fig. 6.



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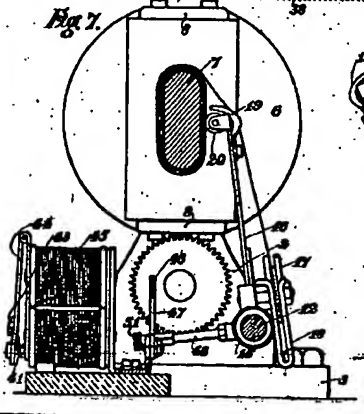

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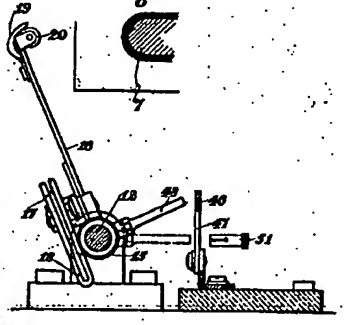

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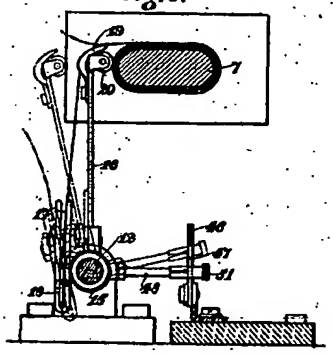
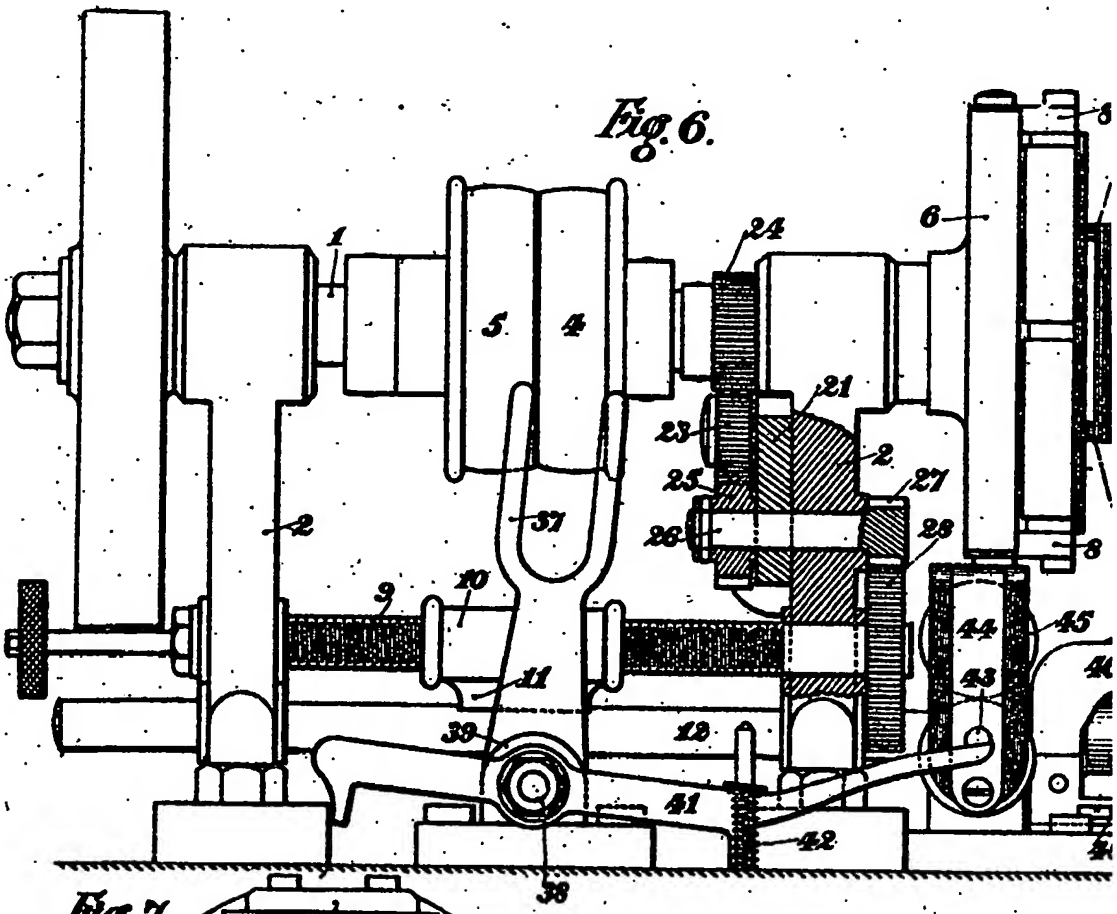


[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 6.



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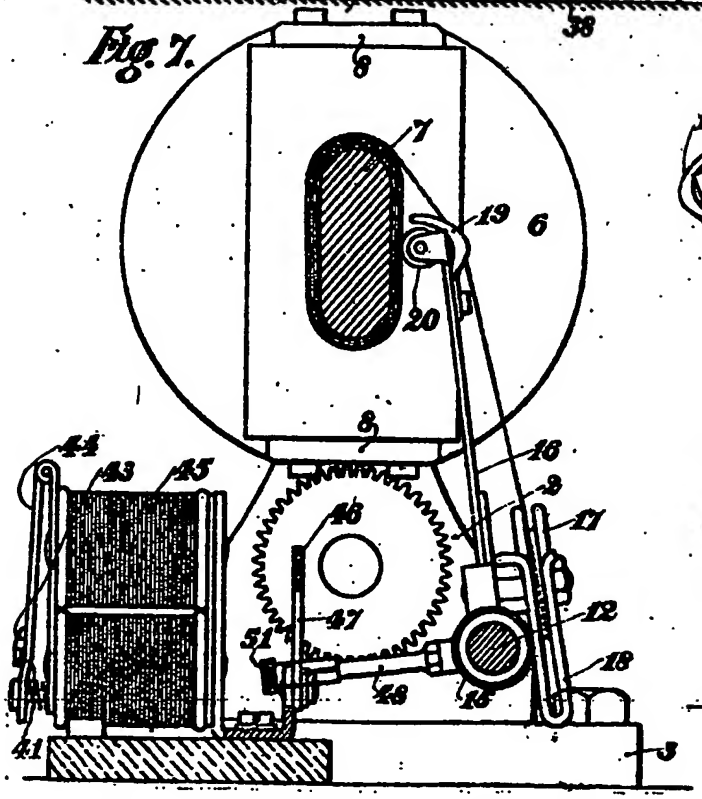

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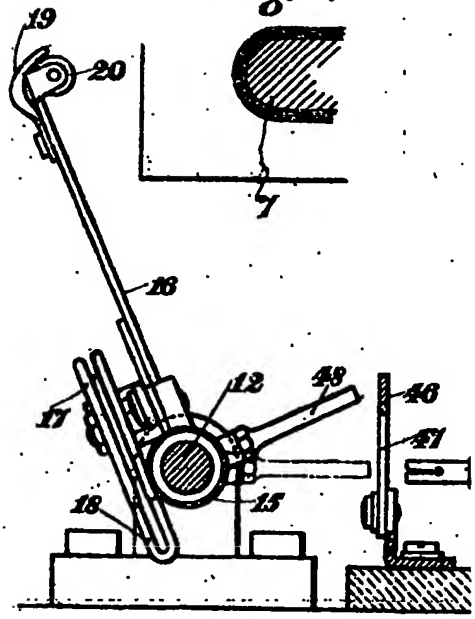

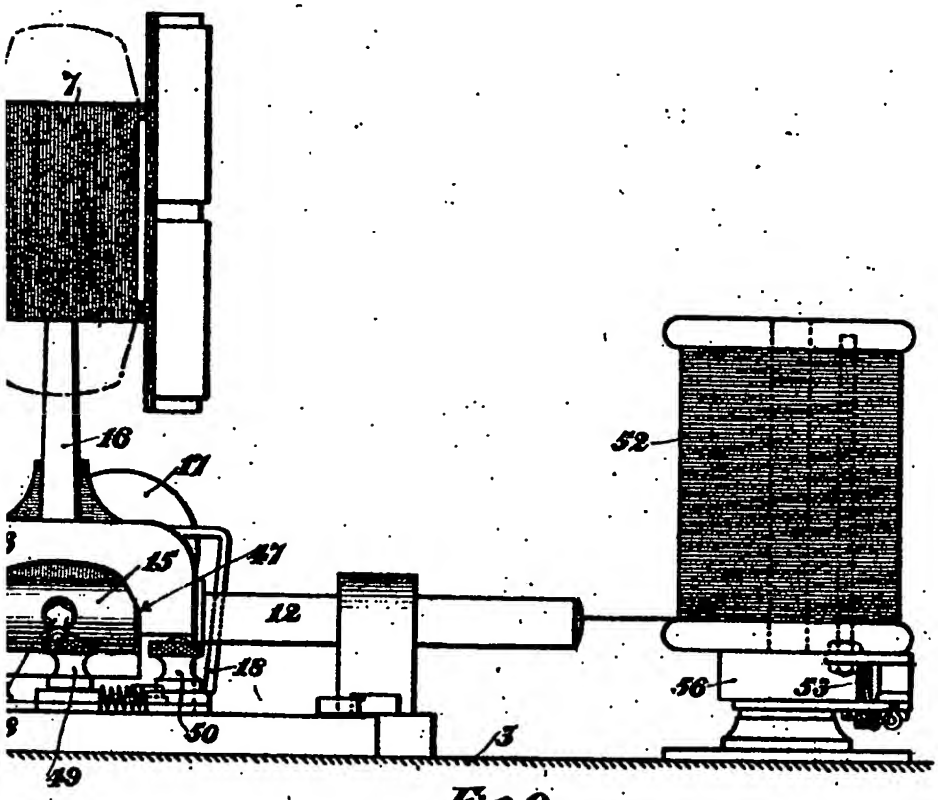

Fig. 9.

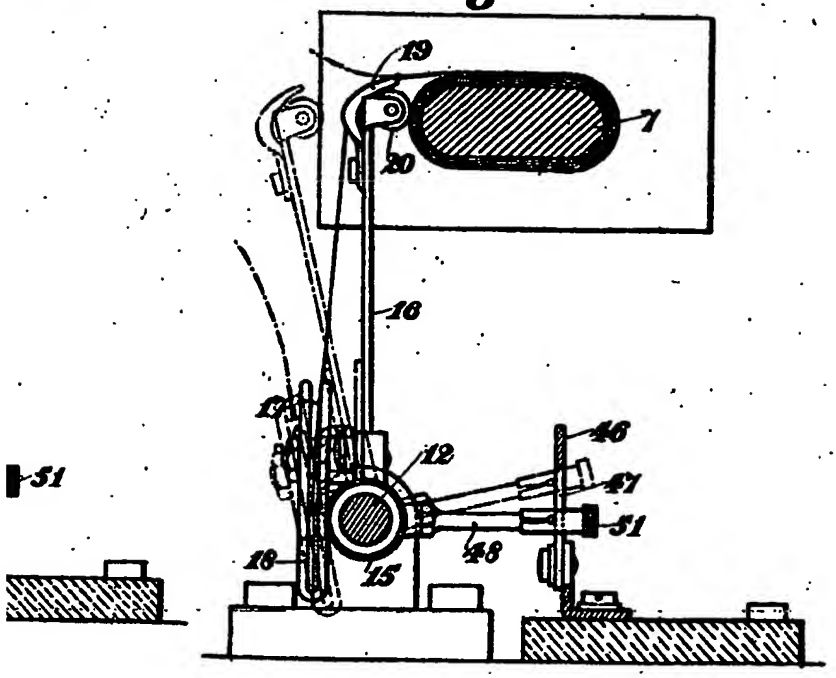

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Fig. 10.

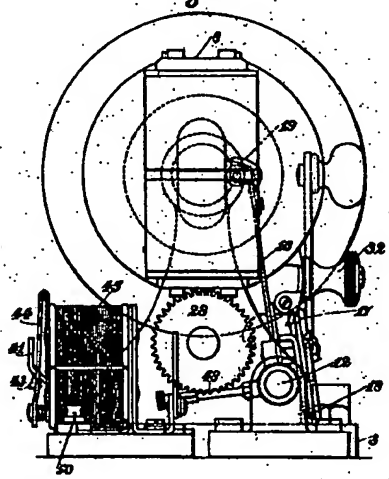


Fig. 11.

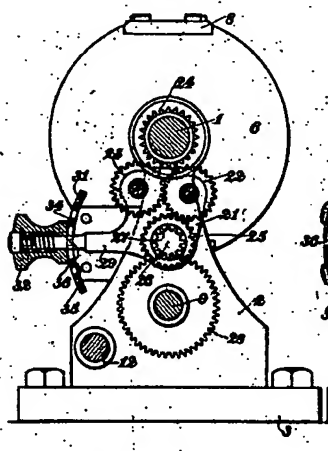
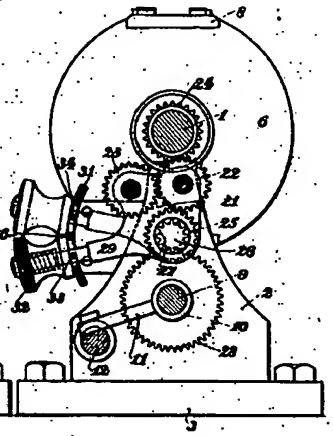


Fig. 12.



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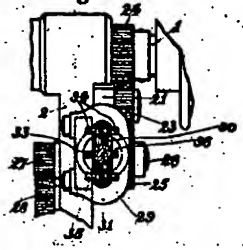
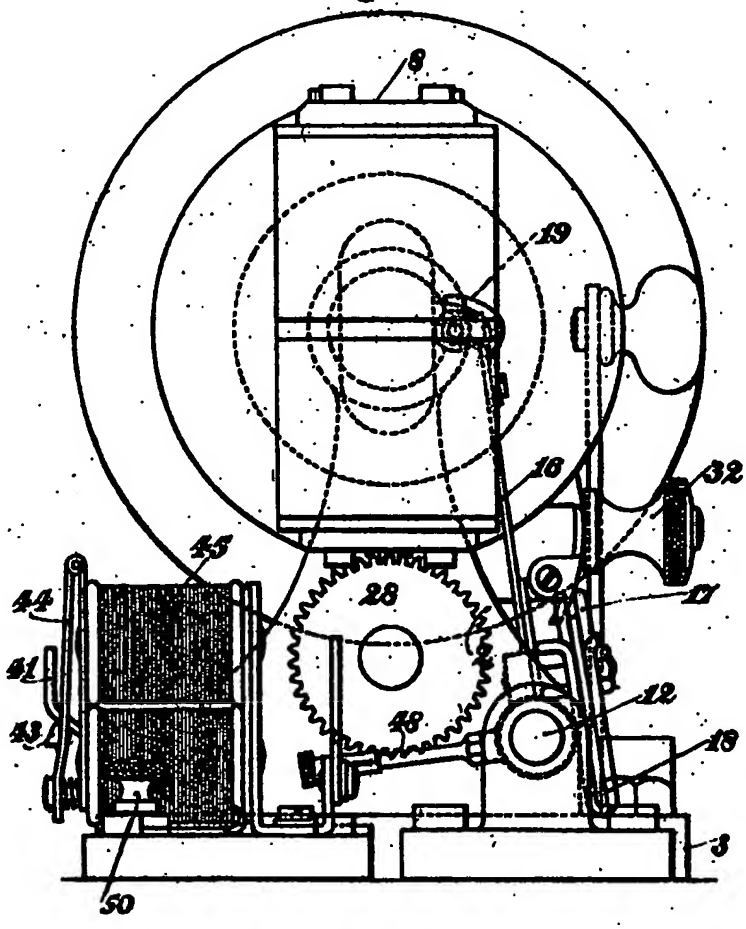


[*This Drawing is a reproduction of the Original on a reduced scale.*]

Fig. 10.



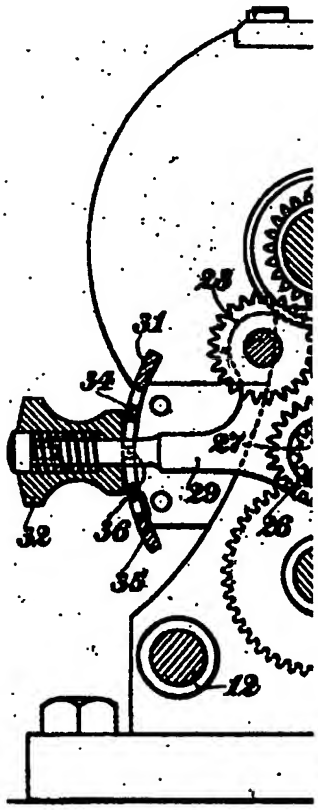
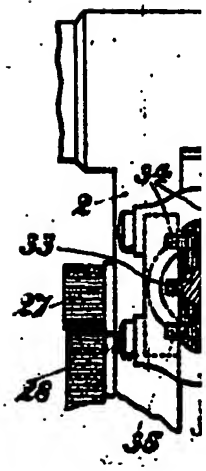


Fig.



g. 11.

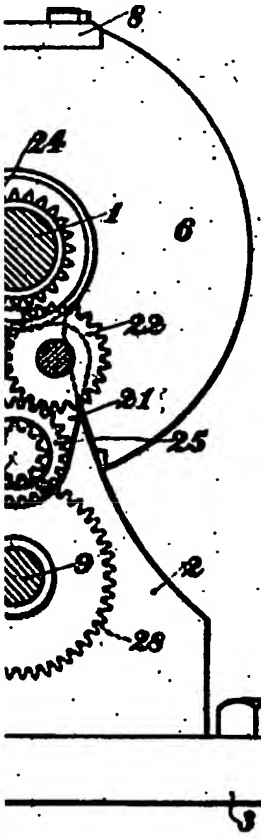
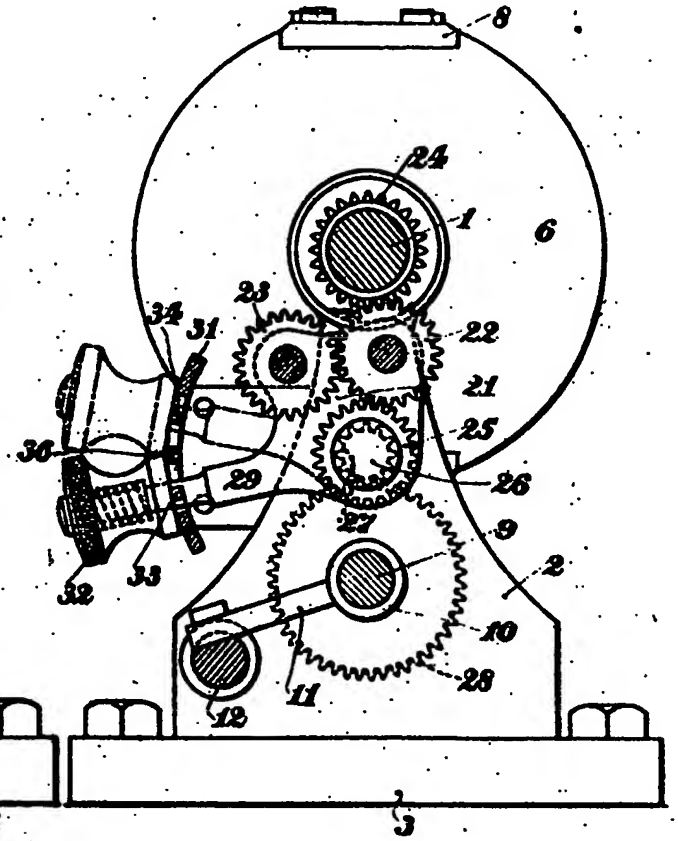


Fig. 12.



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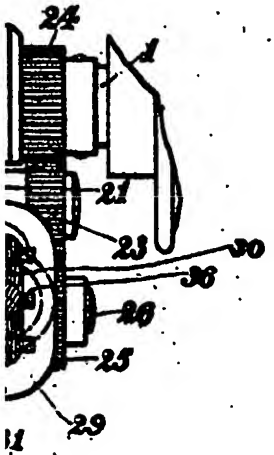

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